Physics

Friction

Friction:- It is the force which opposes the relative motion between the two surfaces in contact and it acts on both the surfaces. In other words, force of friction can be defined as a negative force which opposes the motion of a body. It is a contact force i.e. it comes into being when there is a physical contact between the two bodies. e.g. A rolling ball comes to rest after sometime because of the frictional force. Frictional force is more for a rough surface as compared to a smooth surface and depends on the nature of surfaces, in contact but is independent of the area of contact.

Friction and its cause:- When we roll a ball on the ground or slide one body over the other, frictional force comes into being to oppose the motion of the object. As every object has certain irregularities or deformations on its surface and when we apply force on one body to slide it upon another body, its interlocked irregularities oppose the applied force, which appear to us in the form of friction. That is why a sufficient amount of force has to be applied before one body starts sliding upon another body, it is the same reason: force of friction is more for a rough surface as compared to a smooth surface.

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Types of friction:- There are three main types of friction. These are:-
Static friction:- Its that type of friction which come into being when two non-moving bodies are in contact with each other. It does not allow two bodies to slide upon one another because of the interlocked irregularities. In order to move a body, static friction has to be over come.
Limiting friction:- Its the maximum static friction. If we go on increasing the applied force, the force of friction goes on increasing till we arrive at a stage when the body is just on the point of moving. This stage is called as limiting equilibrium and the force of friction in this case is called as limiting friction.
Dynamic or kinetic or sliding friction:- It's the frictional force when the surfaces in contact are in relative motion. It is slightly less than the limiting friction because more force is required to unlock the irregularities of two stationary bodies as compared to two sliding or moving bodies.
Rolling Friction:- It's the friction which came into being when we roll a body over a surface by means of roller or a wheel. Under similar conditions, rolling friction is much less than sliding friction. Therefore, its easier to roll a given object than to slide it. Due to rolling friction, the surface gets deformed for a short period of time i.e. the time up to the surfaces are in contact with each other and also the roller or the wheel gets deformed too. Due to the deformations produced, an inclined plane is formed and we have to apply the force in order to overcome this temporary inclined plane. And here the applied force gives us the measure of rolling friction. Thus, rolling friction depends on the elevation at the point of contact e.g. Roller skates have tiny wheels. These wheels have very small rolling friction and help in fast motion of the skater.
Laws of Limiting Friction
Limiting friction always opposes the motion of a body and acts in the direction opposite to the direction of applied force.
Limiting Friction depends upon the nature of surfaces in contact with each other.
Limiting friction increases with the increase in the weight of the body and vice versa.
Limiting friction is independent of area of contact between two surfaces: provide the weight of the body and the nature of surface docs not change.

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Friction produced in liquids and gases:-

Liquid 'molecules also oppose the relative motion of its molecules and the opposition offered by liquids is called liquid resistance or simply viscosity, it is noted that when solid moves in a liquid or gas, it also experience friction.

example, the bodies of fishes, aeroplanes are streamlined, body which helps them in reducing the force of friction produced by air or water, called drag when they move through them.

While as the friction offered by air is called air resistance. The resistance offered by air depends on the surface area of the body. More the surface area of the body more will be the friction experienced and vice versa. Example, the body of birds is designed in such a way that air offers least resistance to them and hence they can fly with ease.

Ways to produce friction:- As friction opposes motion and causes wear and tear of the moving parts of machines, therefore we regard it as a curse and often try to minimize. Following are the methods applied for reducing friction:-

By using lubricant:- Lubricant is a substance used to reduce the friction. It comes between the two surfaces and hence the interlocking of the irregularities is greatly reduced which in turn reduces the friction.

By using soap solutions:- Soap solution s are slippery in nature. They are used in reducing friction in high speed cutting and grinding machines, so that not only friction is reduced, but the heat produced during cutting or grinding is rapidly taken away by water present in the soap solution.

By using fine powders:- Graphite is a very soft solid which can be grinded to a very fine state. It is then used as a lubricant in those of parts of machinery, where oil cannot be applied. It fills up irregularities between the surfaces and hence, reduces friction. Similarity, finely powdered talcum is used as a lubricant.

By polishing: - When the surfaces are highly polished, the irregularities are knocked out. This inturn reduces friction.

By streamlining:- The air or water offers a large friction to the bodies moving in them. However, the surface of such bodies is so designed that friction due to air and water is reduced to a large extent. Giving a shape to the bodies, such that they offer the least resistance to the air or water is called streamlined.

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Modern aircraft's, boats and ships are streamlined so as to reduce friction as far as possible.

By converting sliding friction into rolling friction:- It has been found that rolling friction is about 10 times less as compare to sliding friction between the two surfaces. It is for the same reason, many heavy objects, such as suit cases are provided with small wheels, commonly called rollers. The roller reduces friction and hence, suit case can be moved easily.

Friction:- *A Boon*:- As force of friction always opposes motion, it is always considered as a curse. This is not so because very often the force of friction is also a Boon or a necessary evil. Friction is desirable in many ways as:-

i) In an effort to walk, we push the earth backward. In return the earth pushes us forward and we are able to walk. On a highly polished floor, there is a very little grip between the floor and our shoes due to lack of friction. And also the corrugations on the soles of our shoes help us to increase the frictional force between our feet and the ground.

ii) The treads or corrugations on the tyres increases friction and provide them with a better grip on the road.

iii) Further we use friction while applying brakes to our bicycle. When we apply brakes to our bicycle, we are actually clamping rubber blocks against the revolving rim of the wheel. The resulting friction stops the movement of the wheels.

iv) The lighting of a match stick is due to the force of friction. The force of friction raises the temperature of match head to such an extent, that the chemicals in it catch fire to produce flame.

1. *What do you understand by the term friction? Explain how it is caused.*
   a. The force acting along the two surfaces in contact which opposes the motion of one over the other is known as the force of friction or frictional force. Friction is caused due to presence of irregularities which are found on the two surfaces in contact with each other. It is due to the interlocking of irregularities of the two surfaces that produce friction between them. The frictional force increases with the increase in roughness of the surfaces.

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2. *Distinguish between static friction and dynamic friction?*
   a. *Static Friction*:- The friction that exists between the two surfaces in contact when there is no relative motion between them is called static friction.
      It is self adjusting force, that is only as much as is necessary to prevent the motion.
   b. *Dynamic Friction*:- The force of friction acting between two bodies when they are sliding upon one another with a uniform speed is called dynamic friction or sliding friction.
3. *What is limiting friction? state the laws of limiting friction?*
   a. The maximum force of friction when the body just beginning to move is known as limiting friction. Laws of limiting friction:-
      i. Limiting friction always opposes the motion of a body and acts in the direction opposite to the direction-of applied force.
      ii. Limiting friction depends upon nature of surfaces in contact with each other.
      iii. Limiting friction increases with the increase in the weight of the body & vice-versa.
      iv. Limiting friction is independent of area of contact between two surfaces provided the weight of the body and the nature of surface does not change.

4. *How is rolling friction caused?*
   a. The friction experienced by a body, when it is made to move over bodies like roller or a wheel is called rolling friction.

Cause:-

The lower surface of the roller or the wheel gets deformed due to the weight of the rolling object causing depression at the point of contact, because of this deformation (change in shape) of the wheel or roller, a kind of inclined plane is formed. Thus, a force is required to overcome these continuously forward moving inclined planes. This force applied against the continuously forward moving inclined plane is equivalent to the rolling friction.

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5. *Under what conditions the rolling friction increases?*
   a. The rolling friction increases with the increase in depth of depression formed as a result of deformation of the wheel or roller.
1. *State one way of increasing the friction between two surfaces?*
   a. The friction between two surfaces can be increased by making surfaces rough. This can be done by making grooves in the surfaces e.g, tyres or rubbing two surfaces with sand paper to make them rougher.
2. *Name four ways by which friction can be reduced between two surfaces in contact?*
   a. The four ways by which friction can be reduced between two surfaces in contact are:-
      i. By the use of lubricants
      ii. By using soap solution
      iii. By polishing
      iv. By using powder
      v. By streamlining
3. *State two advantages of friction.*
   a. The two advantages of friction are:-
      i. We will be unable to walk if there is not friction between soles of our shoes and the ground, it is because when we push the ground backward, the ground reacts back only on account of friction. If there is not friction, then there will be no reaction from, the ground in forward direction, & hence we slip & fall down.
      ii. It is the force of friction which holds the screws & nails in the wood.
4. *State two disadvantages of friction.*
   a. The two disadvantages of friction are:-
      i. Friction increases the energy required to operate the machines. This energy is wasted in the form of heat energy.
      ii. Friction causes wear & tear in the machines & renders them inoperable.

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iii. Friction reduces the speed of moving vehicles to a great extent.

5. *Why is friction called necessary evil?*
    a. Friction is rightly called necessary evil because it has got advantages as well as disadvantages i.e. on one side it is necessary & in another side has got evil characters.
6. *What is lubricant?*
    a. A lubricant is a substance which, when applied between two surfaces in contact, reduced the force of friction between them e.g. oil, grease or graphite powder.

    How does a lubricant reduce friction?
    a. The lubricant fills the minute unevenness of the two surfaces and separates them by forming a very thin layer in between.

    What kind of lubricant is used in i. sewing machine ii. the axle of a tractor?
    a. Lubricant used in sewing machine is less viscous oil.
    Lubricant used in axle of a tractor is grease or more viscous oil.
7. Name two solid lubricants & state where they are used?
    a. The two solid lubricants are graphite & Fine powder. Graphite is used for heavy parts of machine where oil cannot be applied. Where as Fine powder on the carrom board so as to reduce friction between the carrom board & the coins.
8. What do you understand by the term stream lining? Name a few machines which use stream lining to reduce friction?
    a. In order to reduce the friction due to air & water the bodies are given special shape or design e.g. ships, air-crafts, boats and cars are broad in the middle & narrow in front & at the back, such a process is called stream lining.
9. Why is friction called a preserve force?
    a. As friction has evil character but it is absolutely necessary for carrying out day to day activities. So it is both as a friend as well as foe. This is the reason why it is called preserve force.

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Answer the following question:-

i) Why are the worn out tyres discarded?

   a. The worn out tyres from which grooves are discarded, as they slip on the roads & can cause serious accidents.

ii) Why do carrom coin move faster on carrom board, When dusted with talcum powder?

   a. When talcum powder is dusted on carrom board it fills up irregularities between the surfaces & makes the surface smoothers, thus reducing friction, resulting in the fast movement of carrom coin.

iii) Why is the surface of conveyor belt made rough?

   a. The surface of-the conveyor belt used for turning pulleys & wheels in factories are made rough so that they could provide the necessary reaction, and wheel could turn about their axles.

iv) Why the sewing machine is often oiled?

   a. The sewing machines are often oiled in order to reduce friction. The lubricant separates the two surfaces in such a way that the interlocking of irregularities are greatly reduced as the spaces between them are filled with lubricants (oil).

v) Why do new automobile tyres have deep grooves?

   a. Automobile tyres have deep grooves so as to offer the required amount of friction. This prevents from slipping & sliding of wheel on the road.

vi) Why does a ball rolling on the ground slow down?

   a. The ball rolling on the ground slow down due to force of friction offered by air and between the ball and the ground, the two forces together oppose the forward movement of the ball.

vii) Why are boats & aeroplanes given spherical shape?

   a. (Already discussed above).

viii) Why do meteors burn on entering into the atmosphere?

   a. The meteors (shooting stars) enter the atmosphere of the earth at a very very high speed. At such speeds the-friction due to air is extremely high. Due to this high friction the temperature of meteor rises to such a high degree that they catch fire.

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ix) Why do painters use sand papers in polishing doors?

   a. The painters use sand paper in polishing doors so as to make surface smooth & break the projections on the surface. This makes the surfaces frictionless & glossy.

x) Why is it easier to tie a knot with cotton string as compared to silk string?

   a. Knots are possible only when material offers some friction. As the cotton offers more friction than silk, that is why it is easier to tie a knot with cotton string as compared to silk string.

Qno.2 Fill ups

Do it yourself

Qno.3 Correct the statements:-

1. Sliding friction & slightly more than the limiting friction.
   a. Sliding friction is slightly less than the limiting friction.
2. The conveyor belts are made rough, in order to decrease friction.
   a. The conveyor belts are made rough in order to increase the friction.
3. The friction between two surfaces decreases with increase in the weights of a body.
   a. The friction between two surfaces increases with the increase in weight of a body.
4. The friction offered by the wheels is called sliding friction.
   a. The friction offered by the wheels is rolling friction.
5. The friction increases with the increase in the area of contact at the two surfaces.
   a. The limiting friction is independent of the area of contact of surfaces.

TOPIC: HUMAN RESOURCES....

Q1) Why are people considered a resource ?

Ans: People are considered a resource because they give value to all other resources.They develop resources as per requirement .It is human beings who

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